United States Patent Office 3,701,666
Patented Oct. 31, 1972

3,701,666

PROCESS FOR MAKING AMINO ACID COMPOSITION

Milton Winitz, Palo Alto, Calif., assignor to Morton-Norwich Products, Inc., Chicago, Ill.

No Drawing. Filed Feb. 14, 1968, Ser. No. 705,287
Int. Cl. A23l 1/00
U.S. Cl. 99—1 29 Claims

ABSTRACT OF THE DISCLOSURE

A process for making palatable compositions containing all of the essential amino acids necessary for human nutrition. Particular processes are described for making compositions containing combinations of amino acids, carbohydrates and minerals which are palatable to human taste. Processes are also shown for making palatable chemically defined diets for human consumption containing the above plus vitamins and fat as an aqueous emulsion or in dry form.

This invention relates to amino acid formulations for human consumption to supply all the essential amino acid requirements, and more particularly to processes for making palatable chemically defined diets for human consumption.

Complete diets require the presence of protein, vitamins, minerals, fats, and a source of calories generally in the form of carbohydrates. Natural foodstuffs, such as meat, fruit, grains, and leafy vegetables provide these constituents. It has long been the aim of nutritionists to develop complete synthetic diets that would incorporate these constituents, and such diets have been indeed developed.

Proteins are high molecular weight, highly complex polymers composed of a variety of the so-called essential and non-essential amino acids. Utilization of protein by the animal organism requires that the protein be degraded by the proteolytic enzymes of the gastrointestinal tract to the constituent individual amino acids because the amino acids can be absorbed through the gastrointestinal tract only in the free, uncombined form. The essential amino acids, of which there are considered to be ten in number (leucine, isoleucine, valine, methionine, tryptophan, phenylalanine, threonine, arginine, lysine, histidine), are a vital requirement of the animal species. For a dietary regimen to be considered adequate for the support of all normal physiological functions, it should contain these essential amino acids in the appropriate levels and in the proper proportion of one to the other. The function of the non-essential amino acids is to provide a source of metabolizable nitrogen required by the animal organism for the biosynthesis of proteins, purines, nucleic acids, and other metabolites. Examples of non-essential amino acids include alanine, cysteine, cystine, glycine, proline, glutamic acid, tyrosine, aspartic acid, and serine. Proper nutritional balance requires that these non-essential amino acids be provided in sufficient quantity and within a range of proportions to each other that is less restrictive or critical than the balance required for the essential amino acids.

Amino acids (except glycine) contain one or more asymmetric centers and thus may exist in two or more stereoisomeric forms. Nutritional experience has shown that only the L-isomer of an amino acid can be utilized by the animal organism and that the animal organism has only a very limited capacity for enzymatically converting some amino acids to the L form from the D form. In addition, an oversupply of D-amino acids can be deleterious and can lead to an inhibition of the normal physiological

function. All proteins found in nature contain their constituent amino acids in the L configuration only.

Carbohydrates in a typical dietary regimen are provided in the form of starches, which are high molecular-weight and relatively water-insoluble polymers of glucose. Other sources of carbohydrate, such as lactose (a disaccharide of galactose and glucose) and sucrose (a disaccharide of fructose and glucose), as well as monosaccharides, such as fructose and glucose, occur in natural dietary regimens, but to a much more limited extent. The carbohydrates are employed by the animal organism as a prime source of energy. Prior to utilization by the animal organism, the polymeric or dimeric forms of the carbohydrates are degraded to the constituent monomers by enzymatic action in the gastrointestinal tract in order that they may be absorbed through the gastrointestinal tract.

Lipids typically appear in a natural dietary regimen as fats and oils in the form of triglycerides of three molecules of fatty acids in combination with one molecule of glycerol. The common fatty acids in such triglycerides are those having between 12 and 24 carbon atoms, such as palmitic, stearic, myristic, oleic, linoleic, linolenic, and arachidonic acids. Of these, only linoleic, linolenic, and arachidonic acids have been found to be essential to normal physiological function of animal organisms. The essential fat requirement can be satisfied either by sufficient quantities of linoleic or arachidonic acids, or by combinations of the two, or by linolenic acid in combination with sufficient quantities of either or both of the other two. Degradation of fats prior to absorption through the gastrointestinal tract is accomplished by the enzymatic action of the lipases of the gastrointestinal tract, through which enzymatic action free fatty acids are formed. Other than the essential fats for which there is a vital requirement by the body, fats, like carbohydrates, serve as a source of energy.

Animal organisms have requirements for certain anions and cations of mineral salts, and mineral requirements for certain of the various anions and cations have been established. The ions required in greatest quantity include sodium, potassium, magnesium, phosphorus and chloride ion, whereas other required ions (known as the trace elements), such as iron, manganese, cobalt, copper, molybdenum, zinc, and iodide ion, are required in lesser amounts. Minerals are provided in a natural dietary regimen primarily in the dissociated form (e.g., sodium chloride as the sodium and chloride ions), but they may also occur in the diet in covalent combination with organic molecules (e.g., cobalt in vitamin B-12 and iron in hemoglobin).

Minimum requirements have been established for certain of those vitamins, both water- and fat-soluble, that are known to be necessary for normal physiological function. Vitamins occur in natural dietary regimens either as the free form or combined with other chemical moieties. The water-soluble vitamins include ascorbic acid, thiamine, riboflavin, vitamin B-6, vitamin B-12, pantothenic acid, biotin, inositol, choline, p-aminobenzoic acid; the fat-soluble vitamins include vitamin A, vitamin D, menadione, and tocopherol.

As used in this patent application, the term "defined diet" refers to a diet formulation consisting essentially of highly purified nutrients, essential vitamins, and minerals. If the nutrients of the defined diet are all present in the form of compounds whose precise molecular configuration is known, this defined diet is termed a "chemically defined diet." Nutrients whose precise molecular configuration may not be known and whose inclusion may remove the diet from the chemically-defined-diet category, include, for example, proteins, peptones, starches, dextrins and fats. On the other hand, nutrients whose molecu-